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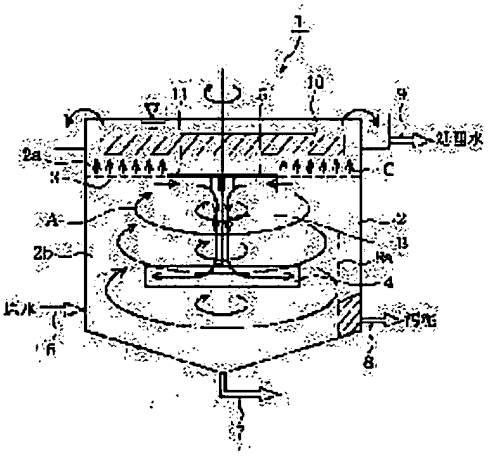
(54) SOLID-LIQUID SEPARATOR HAVING STIRRING FLOW FORMING MEANS

(57)Abstract:

PROBLEM TO BE SOLVED: To increase separation efficiency or a separation speed of solid-liquid separation by controlling the speed and the direction of particles by utilizing inertia, and to provide a compact and inexpensive solid-liquid separator.

SOLUTION: A porous member 3 for dividing an internal space to an upper separation region 2a and a lower flow region 2b is disposed in a separation tank 2. A stirring blade 4 is disposed at the lower flow region 2b. A guide plate 5 for converting whirling flow A generated by the stirring blade 4 to downward flow B is erected at a central part of a lower surface of the porous member 3. Since precipitable material in the water to be treated within the lower flow region 2b is flown by the force of inertia of a horizontal direction due to the whirling flow A generated by rotation of the stirring blade 4, the precipitable material hardly accompanies ascending flow C depending on raw water feeded quantity or the like, receives downward force due to the downward flow B and is separated.



CLAIMS

[Claim(s)]

[Claim 1] The separation tub which carries out solid liquid separation of the processed liquid to sejunction water and the sedimentation nature matter, and the porous member which divides the inside of this separation tub into an up separation region and a lower flow region, The sejunction water derivation means formed in the up separation region, and the churning style means forming prepared in the lower flow region, a processed water installation means and a sedimentation nature matter discharge means, The solid-liquid separator which has the churning style means forming characterized by having the vertical style means forming prepared in the porous member inferior surface of tongue and/or the lower flow region pars basilaris ossis occipitalis.

[Claim 2] Churning style means forming is a solid-liquid separator which has the churning style means forming according to claim 1 characterized by being the radiation style mold impeller equipped with the impeller of one sheet in which the revolution style which goes around horizontally within a lower flow is made to form, or two sheets or more.

[Claim 3] Vertical style means forming is a solid-liquid separator which has the churning style means forming according to claim 1 or 2 characterized by being the guide plate of one sheet or two sheets or more which changes the revolution style of the area within a lower flow in the style of [in alignment with an axial center] a vertical.

[Claim 4] The solid-liquid separator have the churning style means forming carry out having had the separation tub which carries out solid liquid separation of the processed liquid to sejunction water and the sedimentation nature matter, the porous member which divides this separation tub into an up separation region and a lower flow region, the sejunction-water derivation means which were formed in an up separation region, the churning style means forming, the processed liquid installation means and the sedimentation nature matter discharge means which were formed in a lower flow region, and the **** style means forming which were prepared in the internal surface of a lower flow region as the description.

[Claim 5] Churning style means forming is a solid-liquid separator which has the churning style means forming according to claim 4 characterized by being the axial flow mold impeller equipped with the impeller of one sheet in which the circulating flow through which it circulates in the direction of a vertical within a lower flow is made to form, or two sheets or more.

[Claim 6] **** style means forming is a solid-liquid separator which has the churning style means forming according to claim 4 or 5 characterized by being the guide plate of one sheet or two sheets or more which changes the revolution style of the area within a lower flow in the style of [of the direction of an axial center] ****.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the solid-liquid separator used suitable for separation of the liquid phase, such as solid-liquid-separation tubs (separation of sejunction water-coagulation-and-sedimentation sludge), such as a settling basin, a setting tank (separation of treated water-precipitate sludge), a sludge thickener (separation of sejunction water-concentration sludge) in a sludge disposal, and coagulation sedimentation processing, and solid phase at large [in activated sludge treatment].
[0002]
[Description of the Prior Art] Separation according [the technique of solid liquid separation as opposed to waste water etc. generally] to ** gravity (natural sedimentation, coagulation sedimentation, etc.), ** the separation (a cyclone, centrifugal separator, etc.) by the centrifugal force, and ** -- the separation (a filter cloth --) by filtration using the surface of discontinuity which has a minute aperture ** coagulative separation (filtration using condensation adhesion force etc.), such as film, a screen, or a sand stratum, and ** -- it is classified into the separation (electrophoresis separation etc.) by the electric force, the separation (magnetic separation etc.) by ** magnetism, and separation by ** inertial force.
[0003] Among these, although many separation to the classification and separation actuation between the dust collection actuation in mind-****** or **-** by inertial force is used Since it is large compared with a gas, the consistency and viscosity of a liquid are seldom used for solid liquid separation. Only decollator ("cure against overflow of combined sewer system by swirl storm overflow" sewerage association magazine volume [26th] No. 297 1989 / 2 reference by Mr. Shigeo Takeda) extent which used the revolution style like the classifier and swirl using the Coanda effect is known.
[0004] Generally, the separation by inertial force is separated using the ratio of the passing speed (a direction is included) of a particle group, and a solid-liquid-separation rate (a direction is included) accompanying inertial force by flow of the slurry in equipment.
[0005]
[Problem(s) to be Solved by the Invention] However, in the decollator by the conventional inertial force, the separability ability was decided by ** raw water inflow, and the configuration and magnitude of ** equipment, and the technical problem that neither separation efficiency nor a separation rate could be enlarged occurred. Moreover, the usual solid-liquid separators (settling basin etc.) took the vast site, in order to obtain the stable quality of treated water, and the technical problem that various kinds of equipment was needed also occurred.
[0006] It was made in order that this invention might solve the above technical problems, and it aims at raising the separation efficiency and the separation rate of solid liquid separation by controlling the passing speed and the migration direction of a particle group by inertial force, and offering a cheap solid-liquid separator with a compact.
[0007]
[Means for Solving the Problem] The solid-liquid separator which has the churning style means forming concerning this invention The separation tub which carries out solid liquid separation of the processed liquid to sejunction water and the sedimentation nature matter, and the porous member which divides the inside of this separation tub into an up separation region and a lower

flow region, It is characterized by having the sejunction water derivation means formed in the up separation region, the churning style means forming prepared in the lower flow region, a processed water installation means and a sedimentation nature matter discharge means, and the vertical style means forming prepared in the porous member inferior surface of tongue and/or the lower flow region pars basilaris ossis occipitalis.

[0008] The solid-liquid separator which has the churning style means forming concerning this invention is characterized by using the radiation style mold impeller equipped with the impeller of one sheet in which the revolution style which goes around horizontally within a lower flow as churning style means forming is made to form, or two sheets or more.

[0009] The solid-liquid separator which has the churning style means forming concerning this invention is characterized by using the guide plate of one sheet or two sheets or more which changes the revolution style of the area within a lower flow in the style of [in alignment with an axial center] a vertical as vertical style means forming.

[0010] The solid-liquid separator which has the churning style means forming concerning this invention The separation tub which carries out solid liquid separation of the processed liquid to sejunction water and the sedimentation nature matter, and the porous member which divides this separation tub into an up separation region and a lower flow region, It is characterized by having the sejunction water derivation means formed in the up separation region, the churning style means forming, processed liquid installation means and sedimentation nature matter discharge means which were formed in the lower flow region, and the **** style means forming prepared in the internal surface of a lower flow region.

[0011] The solid-liquid separator which has the churning style means forming concerning this invention is characterized by using the axial flow mold impeller equipped with the impeller of one sheet in which the circulating flow through which it circulates in the direction of a vertical within a lower flow is made to form as churning style means forming, or two sheets or more.

[0012] The solid-liquid separator which has the churning style means forming concerning this invention is characterized by being the guide plate of one sheet or two sheets or more which changes the revolution style of the area within a lower flow in the style of [of the direction of an axial center] **** as **** style means forming.

[0013]

[Embodiment of the Invention] Hereafter, one gestalt of implementation of this invention is explained.

Gestalt 1. drawing 1 of operation is the sectional view showing the configuration of the solid-liquid separator by the gestalt 1 of implementation of this invention, and drawing 2 is the top view of drawing 1 . In drawing, 1 is a solid-liquid separator. The plate-like porous member 3 which a solid-liquid separator 1 is arranged horizontally in the closed-end approximate circle tubed separation tub 2 and this separation tub 2, and divides the separation tub 2 into up separation region 2a and lower flow region 2b, The impeller 4 which hangs from the upper part of the separation tub 2, and forms the revolution style A parallel to the inferior surface of tongue of the porous member 3 (churning style means forming), The guide plate 5 which changes into the Shimo counterflow B the revolution style A which it was prepared in the inferior surface of tongue of the porous member 3, and was produced by the impeller 4 (vertical style means forming), The raw water induction 6 for introducing raw water (processed liquid) into lower flow region 2b (processed liquid installation means), The sludge fetch section 7 for discharging sedimentation nature matter, such as a sludge in lower flow region 2b of the separation tub 2, out of equipment (sedimentation nature matter discharge means), The concentration sludge fetch

section 8 which discharges the concentration sludge which it was prepared in the pars basilaris ossis occipitalis in lower flow region 2b of the separation tub 2, and sedimentation nature matter, such as a sludge, was made to sediment, and was condensed out of equipment (sedimentation nature matter discharge means), The outline configuration is carried out from the treated water fetch section (sejunction water derivation means) 9 which uses the sejunction water in up separation region 2a of the separation tub 2 as treated water, it is made to carry out overflow, and discharges it, and the sedimentation promotion member 10 which promotes sedimentation of the sedimentation nature matter (pin flocks etc.) which remains in sejunction water.

[0014] The pars basilaris ossis occipitalis of the separation tub 2 is formed in the cone configuration, and the sludge fetch section 7 is formed in the deepest part. Since the revolution style A which goes around horizontally by rotation of the stirring aerofoil 4 in lower flow region 2b is formed, the horizontal section of the separation tub 2 in the gestalt 1 of this operation is made circular so that that revolution style A is formed and may be easy to be maintained within lower flow region 2b certainly, but if it has the horizontal section of point symmetry, such as a regular octagon and a forward hexagon, for example, there will be especially no limit.

[0015] The porous member 3 is a plate-like thing which classifies both regions so that it may have two or more through tubes which do not bar passage of the sejunction water which raw water or the sedimentation nature matter separated and a flow of lower flow region 2b may not attain to up separation region 2a in general. As this porous member 3, the shape of a wire gauze, a punching plate, an expanded metal, a special perforated plate, and sheet metal, a granular packed bed, etc. can be used, for example. Moreover, the porous member 3 is horizontally installed so that the separation tub 2 may be divided up and down between lower flow region 2b in which an impeller 4 is located, and up separation region 2a in which the treated water fetch section 9 is located. In addition, in order to prevent the upper counterflow which goes up in accordance with a wall near the wall in order to prevent that an upper counterflow is formed, in case the Shimo counterflow B is made to change the revolution style A into the part by which the guide plate 5 was set up among the porous members 3, it is desirable to form the water cutoff member 11, as it is shown in drawing 1 and drawing 2 whether the above-mentioned through tube is prepared.

[0016] It is the agitator (stirring equipment) which the stirring aerofoil is generally equipped with a singular impeller or two or more singular impellers, and this stirring aerofoil 4 is fixed to one shaft, and has a driving means (not shown). In addition, two or more stirring aerofoils can also be prepared in one shaft (multistage type). The configuration of the impeller 4 in the gestalt 1 of this operation is a radiation style mold which forms the revolution style A which mainly goes around horizontally in lower flow region 2b as shown in drawing 1 . This radiation style type of stirring aerofoil has the configuration which forms the flow which mainly goes around horizontally, when a monotonous impeller generally rotates. Although four wings are arranged at the revolving shaft as shown in the stirring aerofoil 4 at drawing 2 , the number of aerofoils does not have a limit in the number of stages that there should just be at least one step. Moreover, the number of sheets of the wing of the stirring aerofoil 4 was not limited. The installation location of an impeller 4 prepared in lower flow region 2b is made into between the porous member 3 and the partes basilaris ossis occipitalis of the separation tub 2, and is suitably set [from] up among the upper part, CHUBU ENGINEERING CORPORATION, and the lower part according to the internal configuration of the separation tub 2, the installation location of a guide plate 5, etc. The rotational frequency of an impeller 4 can be suitably changed by control of a driving gear (not shown) in consideration of the physical properties of the very fine particle group which is the

sedimentation nature matter in a processed liquid. It is better to use the radiation style mold which can form water plain streams, such as a paddle mold well-known in order to generate a revolution style efficiently, a special paddle mold, a standard lath ton mold, and a turbine mold, as a configuration of an impeller 4 although the aerofoil of all configurations can be used. if the bore of lower flow region 2b is set to L and the path of an impeller 4 is set to D, in order to acquire an ideal churning condition within lower flow region 2b by the impeller 4 -- a ratio -- both dimension is set up so that the range of D/L=0.3-0.7 may be filled. In addition, when the stirring aerofoil 4 cannot be installed on account of the configuration of the separation tub 2 etc., the jet equipments (circulator etc.) which can make flow horizontal in lower flow region 2b may be installed.

[0017] As shown in drawing 1 , it is installed in the inferior surface of tongue of the porous member 3 in the state of suspension, as shown in drawing 2 , four plates are being fixed to the radial centering on the core of the porous member 3, and a guide plate 5 changes into the Shimo counterflow B a part of revolution style A which collided with this. This vertical style B means the flow of the direction of a vertical which a part of revolution style A produces with a guide plate 5. Incidentally, a guide plate 5 changes a part of revolution style A into upper counterflow B', when setting up at the pars basilaris ossis occipitalis of lower flow region 2b so that it may be later mentioned with the gestalt 2 of operation. Moreover, the curve configuration may be made although a guide plate 5 is the plate-like thing of a square or a rectangle. In addition, at least one number of sheets of a guide plate 5 does not have a limit in the number of sheets that what is necessary is just to be.

[0018] As shown in drawing 2 , in order not to disturb the revolution style A formed of an impeller 4, the installation location of the raw water induction 6 is considered so that raw water may be introduced in lower flow region 2b along with the internal surface of approximately cylindrical lower flow region 2b. Although the installation to lower flow region 2b of raw water may use introductory tubing, using opening prepared in the wall, it is desirable to introduce so that level flow which the wall of lower flow region 2b is made to meet may be formed so that the revolution style A in lower flow region 2b may not be checked in any and formation and maintenance of the revolution style A can be performed. In addition, the revolution style A can be efficiently formed and maintained in lower flow region 2b by combining with revolution style means forming, such as the impeller 4 mentioned above.

[0019] The sludge fetch section 7 is formed in the pars basilaris ossis occipitalis in lower flow region 2b, draws out sedimentation nature matter, such as a sludge, the concentration sludge fetch section 8 forms the part into which the effect of a churning flow by the impeller 4 or the guide plate 5 is eliminated by septum 8a prepared in a part of separation tub 2, and a flow stands it still, and it makes a sludge sediment in the septum 8a, condenses it, and discharges the concentration sludge out of equipment. In addition, this concentration sludge fetch section 8 is formed if needed.

[0020] The catchment facility which makes homogeneity a flow in up separation region 2a as the treated water fetch section 9, and catches water can be used. When it is prepared if needed and forms this sedimentation promotion member 10, the sedimentation promotion member 10 The parallel plate which combined two or more parallel plates with predetermined clearance, Ramps, such as a COL gated image plate which combined two or more corrugated plates with predetermined clearance, Although rectification material, such as sedimentation tubing which combined two or more tubes and square tubes, a packed bed which it is filled up with a short pipe or granular support into supporting material or a framework, and separation area is

increased, and raises the separation effectiveness, a perforated plate, or a screen, etc. can be used If sedimentation of the pin flocks which remain in the sejunction water in up separation region 2a is promoted, it will not be restricted especially. In addition, a ramp and sedimentation tubing may be installed as it is in the separation tub 2, and may be supported and installed with supporting material.

[0021] The operation in the solid liquid separation in the separation tub 2 of such a configuration is explained. When the solid liquid separation by inertial force generally takes a swirl etc. for an example, a separation rate VL is shown by VL=(QI-Qu)/S by the tub cross section S, the undiluted solution inflow QI, and the sludge discharge Qu. When devise the flowing method in a swirl, the revolution style A of the rate of flow Vc of a bigger rate than a separation rate VL is generated in equipment, a particle group is put in the style of [the / A] revolution and it is made to move, the particle group then, with the inertial force The very fine particle group which it is hard coming to accompany to the upward flow C of a separation rate VL, and has a settling velocity smaller than a separation rate VL does not go up, either, but since it rides and exercises for the flow of the revolution style A, a small particle group is also separable. However, since magnitude of the revolution style A cannot be taken greatly, or turbulence by the revolution style A is in a separation region and separation efficiency worsens, at the swirl, the sludge discharge Qu tends to be enlarged, a separation rate VL tends to be made small, and it is going to raise separation efficiency in the swirl.

[0022] So, with the gestalt 1 of this operation, as shown in drawing 1 , the stirring aerofoil 4 which can change a rotational frequency freely is installed in lower flow region 2b. If the force is applied to the raw water introduced in lower flow region 2b by rotating it, the revolution style A is generated in lower flow region 2b and it enables it to take the rate greatly compared with conventional equipment Since inertial force horizontal also to a very fine particle group with a settling velocity smaller than a separation rate VL is given and it is exercising by it, it is hard coming to accompany to the upward flow C of a separation rate VL. Since inertial force is larger than before, it has further been hard coming to go it together. That is, separation efficiency and a separation rate can be taken greatly. However, since a flow by stirring reaches in [whole] the separation tub 2, the effect on up separation region 2a must be lost.

[0023] That is, since the flow rates about a flow in lower flow region 2b are the raw water inflow QI and the stirring discharge quantity Qd, QI+Qd is to a base. Therefore, the index representing the mean velocity in the separation tub 2 is set to Va=(QI+Qd)/S. although the revolution style A of the rate of flow Vc occurs by this QI+Qd, if it has the influence of such stirring on up separation region 2a of the separation tub 2 -- that separation rate VL -- ' -- it is set to VL'=(QI+Qd-Qu)/S, and since a separation rate becomes large only in the part of Qd, naturally separation efficiency worsens. Therefore, separation efficiency increases by setting stirring discharge quantity Qd to 0 (zero) about separation.

[0024] Then, from the installation location of the stirring aerofoil 4, although it passes in a suitable upside location, water installs horizontally the porous member 3 which prevents a flow in it so that the separation tub 2 may be divided up and down. Thereby, although the effect of stirring is effective in lower flow region 2b of the porous member 3 bottom, effect is lost in upper up separation region 2a. Therefore, since the upward flow C of up separation region 2a is set to separation rate VL=(QI-Qu)/S, separation efficiency becomes good. Thus, since the rate of flow Vc of the revolution style A can be greatly taken compared with the conventional solid-liquid separator, separation efficiency and a separation rate can be taken greatly.

[0025] Next, actuation is explained. First, the raw water containing the very fine particle group

which is the sedimentation nature matter is introduced by the fixed flow rate in lower flow region 2b from the raw water induction 6. Under the present circumstances, it makes the revolution style A horizontal in lower flow region 2b easy to introduce raw water along with the internal surface of lower flow region 2b, as shown in drawing 2 , and to generate. Since it is horizontally arranged at this time so that the porous member 3 may divide the separation tub 2 up and down, in up separation region 2a of the porous member 3 top, the loose upward flow C of the effect of stirring by the stirring aerofoil 4 which is not almost is formed of the inhibitory action of the porous member 3 which forms this surface of discontinuity.

[0026] Next, a strong flow is given to the raw water introduced in lower flow region 2b by rotation of an impeller 4. A part of this revolution style A turns into the Shimo counterflow B which descends towards the pars basilaris ossis occipitalis of lower flow region 2b in accordance with a revolving-shaft alignment with a guide plate 5 at the same time the revolution style A which goes around along the inner circle wall side of lower flow region 2b in the pars basilaris ossis occipitalis in lower flow region 2b by the impeller 4 of a radiation style mold is formed at this time. This Shimo counterflow B gives the down force to the very fine particle group it has been hard coming to accompany to upward flow C with the inertial force given by the revolution style A, and the very fine particle group which it is going to separate from upward flow C according to this Shimo counterflow B is separated efficiently. Thus, since it is flowed and condensed with lower flow region 2b of the porous member 3 bottom and sludge concentration becomes high, the separated very fine particle group is suitably drawn out from the sludge fetch section 7 or the concentration sludge fetch section 8 prepared in the pars basilaris ossis occipitalis of lower flow region 2b as a sludge. Depending on the case, the stirring aerofoil 4 may be temporarily stopped before drawing out, sedimentation nature matter, such as a very fine particle group, is settled at the pars basilaris ossis occipitalis, it may precipitate and the high-concentration-ized sludge may be drawn out.

[0027] On the other hand, the supernatant liquid which the sedimentation nature matter separated rides on upward flow C, passes up separation region 2a, and it is made it to carry out overflow from the treated water fetch section 9. In that case, by using the sedimentation promotion members 10, such as a ramp formed in up separation region 2a, the sedimentation removal of the pin flocks which accompanied upward flow C can be carried out, and still higher-quality treated water can be obtained.

[0028] as mentioned above, the thing which was established for the stirring aerofoil 4 as churning style means forming according to the gestalt 1 of this operation -- the horizontal revolution style A of the larger rate of flow than a climbing speed -- being physical (mechanical) -- it can be formed, inertial force can be given to the very fine particle group in the flowing raw water, and it can bar accompanying to the upward flow C to which a very fine particle group goes up the inside of up separation region 2a by this, and going up. Moreover, although a very fine particle group receives the above force not a little since raw water carries out a sequential inflow at lower flow region 2b and upward flow C is maintained Since a part of revolution style A can be made into the Shimo counterflow B in alignment with a revolving-shaft alignment by having formed the guide plate 5 as vertical style means forming The down force can be given to the very fine particle group in raw water according to this Shimo counterflow B. In the conventional solid-liquid separator, regardless of raw water inflow, or the configuration and magnitude of equipment which were a rate limiting factor, compared with general gravity precipitate, it is efficient at the short residence time, and solid liquid separation of the raw water can be carried out to a very fine particle group and sejunction water.

[0029] With the gestalt 1 of this operation, since a separation rate and separation efficiency can be sharply raised compared with the conventional solid-liquid separator by having formed the guide plate 5 as the stirring aerofoil 4 and vertical style means forming as the porous member 3 and stirring style means forming, it becomes compacter, plottage can also be made small and a construction cost can also be made cheap.
[0030] With the gestalt 1 of this operation, if the rotational frequency which was adapted for the physical properties of the very fine particle group which is the sedimentation nature matter in raw water by having enabled modification of the rotational frequency of the stirring aerofoil 4 as churning style means forming is chosen, also with the same equipment, it is adapted for the water quality of raw water, or change of amount of water, and can process.
[0031] In addition, although the pars basilaris ossis occipitalis of the separation tub 2 was made into the cone configuration with the gestalt 1 of this operation, it is good also as a flat side.
[0032] Gestalt 2. drawing 3 of operation is the sectional view showing the configuration of the solid-liquid separator by the gestalt 2 of implementation of this invention. The same sign is attached about the part which is common in the component of the gestalt 1 of operation among the components of the gestalt 2 of this operation, and explanation of that part is omitted.
[0033] With the gestalt 2 of this operation, the guide plate 5 as vertical style means forming is set up at the pars basilaris ossis occipitalis of the separation tub 2, and the stirring aerofoil 4 as churning style means forming which forms the revolution style A between this guide plate 5 and the porous member 3 is arranged. this -- operation -- a gestalt -- two -- **** -- drawing 3 -- being shown -- as -- the lower part -- a flow -- a region -- 2b -- inside -- the upper part -- being located -- stirring -- an aerofoil -- four -- having been generated -- being horizontal -- revolution -- a style -- A -- the lower part -- a flow -- a region -- 2b -- a pars basilaris ossis occipitalis -- setting up -- having had -- a guide plate -- five -- a revolving shaft -- an alignment -- meeting -- going up -- upward flow -- B -- ' -- changing -- having -- although -- Turn the inside of lower flow region 2b near the inferior surface of tongue of the porous member 3 to the periphery section of the porous member 3 by rotation of an impeller 4, and it is sent out. It can become the Shimo counterflow B (down vertical style) along the inner circle wall side of lower flow region 2b, the down force can be given to the very fine particle group in raw water according to this Shimo counterflow B, and the increase in efficiency of solid liquid separation can be attained. Moreover, near the lower layer of lower flow region 2b can be enough agitated also in the direction of a vertical, and the inside of lower flow region 2b can be homogenized.
[0034] According to the gestalt 2 of this operation, with as mentioned above, the guide plate 5 set up at the pars basilaris ossis occipitalis of lower flow region 2b Since the revolution style A is changed into upward flow B' (above vertical style) which goes up in accordance with the revolving shaft of the stirring aerofoil 4 and it can change into the Shimo counterflow B (down vertical style) which acts as Shimomukai near the periphery section of the porous member 3 Like [can give the down force by this to a very fine particle group, and] the case where it is the gestalt 1 of operation While it is efficient at the short residence time compared with the conventional coagulative separation equipment by gravity precipitate and being able to carry out solid liquid separation of the processed liquid to the sedimentation nature matter and sejunction water, the inside of lower flow region 2b can be homogenized.
[0035] With the gestalt 2 of this operation, although the sedimentation promotion member (not shown) in the gestalt 1 of operation is not prepared in up separation region 2a, you may prepare if needed. Moreover, with the gestalt 2 of this operation, although the concentration sludge fetch section (not shown) in the gestalt 1 of the operation to lower flow region 2b is not prepared, you

may prepare if needed.
[0036] Gestalt 3. drawing 4 of operation is the sectional view showing the configuration of the solid-liquid separator by the gestalt 3 of implementation of this invention. The same sign is attached about the part which is common in the component of the gestalt 1 grade of operation among the components of the gestalt 3 of this operation, and explanation of that part is omitted.
[0037] With the gestalt 3 of this operation, the thing of the axial flow mold which forms the circulating flow D which mainly stirs the inside of lower flow region 2b in the direction of a vertical as a stirring aerofoil 4 is adopted, it is the periphery section of the porous member 3, and two or more guide plates 5 (**** style means forming) are set up by the internal surface of lower flow region 2b, or its near. Moreover, in order to prevent that the below-mentioned upper counterflow shifts to up separation region 2a from lower flow region 2b, it is desirable to form the water cutoff member 11, as a through tube is not prepared in the periphery section of the porous member 3 or it is shown in drawing 4 .
[0038] It is the agitator (stirring equipment) which the stirring aerofoil is generally equipped with a singular impeller or two or more singular impellers, and this stirring aerofoil 4 is fixed to one shaft, and has a driving means (not shown). In addition, two or more stirring aerofoils can also be prepared in one shaft (multistage type). The axial flow mold which can form circulating flow, such as a well-known propeller mold, a paddle mold, a hydrofoil mold, and a turbine mold, as a configuration of the impeller 4 in the gestalt 3 of this operation can be used. Moreover, although it is cylindrical like what was adopted with the gestalt 1 of operation as a configuration of the separation tub 2, if it is the configuration from which formation of the homogeneous circulating flow D in lower flow region 2b is not prevented especially, it will not be restricted to this. What has a horizontal section symmetrical with a point desirably is good. And in order to make circulating flow D of the vertical direction easy to bar formation of the below-mentioned revolution style A, and to form, it is effective if the baffle 12 (baffle) which extends in the direction of a vertical in the wall of lower flow region 2b is formed. As long as raw water installation into the separation tub 2 from the raw water induction 6 is performed to lower flow region 2b in connection with this, it may be carried out in what kind of direction. In addition, although the stirring aerofoil 4 consists of two wings as shown in drawing 2 , at least one number of sheets of a wing does not have a limit in the number of sheets that what is necessary is just to be.
[0039] Next, a flow in the separation tub 2 is explained. When the impeller of the shape of a propeller of the stirring aerofoil 4 rotates, a stream to vertical down Discharge, The horizontal bottom current which faces to a wall from a revolving-shaft alignment at the pars basilaris ossis occipitalis of lower flow region 2b is formed. The upper counterflow which goes up in accordance with a wall is formed, the water plain stream (**** style) E is formed for this upper counterflow of the porous member 3, and a series of circulating flow D which joins the above-mentioned Shimo counterflow B near the revolving-shaft alignment is formed in lower flow region 2b. Moreover, the revolution style A which goes lower flow region 2b around horizontally secondarily in rotation by the stirring aerofoil 4 of an axial flow mold is formed. The circulating flow D formed of the stirring aerofoil 4 consists of flow (an upper counterflow and the Shimo counterflow B) of the direction of a vertical, and horizontal flow (a bottom current and the **** style E) which flows between a revolving-shaft alignment and walls along with the revolving shaft of the stirring aerofoil 4, and the internal surface of lower flow region 2b. The revolution style A secondarily produced by rotation of the stirring aerofoil 4 which is a **** is changed into **** style E' which tends toward a revolving-shaft alignment by colliding with a guide plate 5

and which is a water plain stream, and it is used in order to supplement with the **** style E of the circulating flow D by the stirring aerofoil 4 and to gather effectiveness.
[0040] Within lower flow region 2b, stirring mixing is performed by the circulating flow D by the stirring aerofoil 4, while the **** style E is formed, **** style E' changed by the guide plate 5 is formed, and inertial force horizontal to sedimentation nature matter, such as a very fine particle group in raw water, is given by these.
[0041] Now, in order that it may ride on horizontal **** style E+E' and a very fine particle group may move, especially a small very fine particle group can give the down force to a very fine particle group according to the Shimo counterflow B which stops being able to accompany to upward flow C easily, and is further produced in accordance with a revolving-shaft alignment with inertial force, and, thereby, a very fine particle group is efficiently separated from upward flow C. Thus, the separated very fine particle group remains in lower flow region 2b, and the sejunction water which the very fine particle group separated rides on upward flow C, passes up separation region 2a, and it is made it to carry out overflow from the treated water fetch section 9. In that case, by using sedimentation promotion members (not shown), such as a ramp formed in up separation region 2a, the sedimentation removal of the pin flocks which accompanied upward flow C can be carried out, and still higher-quality treated water can be obtained.
[0042] In lower flow region 2b, since the very fine particle group separated according to the Shimo counterflow B remains, and is condensed and sludge concentration becomes high, it draws out outside directly suitably from the sludge fetch section 7 prepared in the pars basilaris ossis occipitalis. Depending on the case, an impeller 4 may be temporarily stopped before drawing out, sludge may be settled at the pars basilaris ossis occipitalis, and the high-concentration-ized sludge may be drawn out.
[0043] As mentioned above, while forming in lower flow region 2b the water plain stream (**** style E) which tends toward a revolving-shaft alignment on the inferior surface of tongue of the porous member 3 by having formed the impeller 4 of an axial flow mold according to the gestalt 3 of this operation Since the revolution style A is furthermore convertible for **** style E' with a guide plate 5 It is made hard to accompany to the upward flow C which passes the porous member 3 by giving horizontal inertial force also to the sedimentation nature matter with a settling velocity smaller than a separation rate VL. Furthermore, the down force can be given to a very fine particle group according to the Shimo counterflow B. Separation efficiency and a separation rate can be raised like the case of the gestalt 1 grade of operation by this, and solid liquid separation can be efficiently performed in a short time compared with general gravity precipitate regardless of raw water inflow, or the configuration and magnitude of equipment which were a rate limiting factor in the conventional solid-liquid separator.
[0044]
[Effect of the Invention] While making it hard according to this invention to give horizontal inertial force to the sedimentation nature matter in raw water in a lower flow region, and to accompany to upward flow by having established a porous member and churning style means forming, as explained above Use the vertical down Shimo counterflow which will be formed of vertical style means forming if stirring style means forming is revolution style means forming, and if stirring style means forming is circulating flow means forming Because use the vertical down Shimo counterflow which constitutes the circulating flow and this gives the down force to the sedimentation nature matter In the conventional solid-liquid separator, solid liquid separation can be efficiently performed in a short time compared with general gravity precipitate regardless of raw water inflow, or the configuration and magnitude of equipment which were a rate limiting

factor. Therefore, since it is suitable for solid-liquid-separation actuation of sedimentation nature matter, such as a very fine particle group, especially the solid-liquid separator concerning this invention is effective if it applies to the solid-liquid-separation actuation of a water treating unit and an ooze processing equipment in the solid-liquid-separation actuation in a chemical process, water environmental preservation, and water use.

[0045] Since a separation rate and separation efficiency can be sharply raised compared with the conventional solid-liquid separator by having established a porous member, churning style means forming and vertical style means forming, or **** style means forming according to this invention, it becomes compacter, plottage can also be made small and a construction cost can also be made cheap.

[0046] Since this can be made to sediment promptly according to this invention even if it is the case where pin flocks etc. are contained in the sejunction water which passed the porous member by having prepared the sedimentation promotion member in the up separation region, separation efficiency and the quality of treated water can be raised.

[Translation done.]

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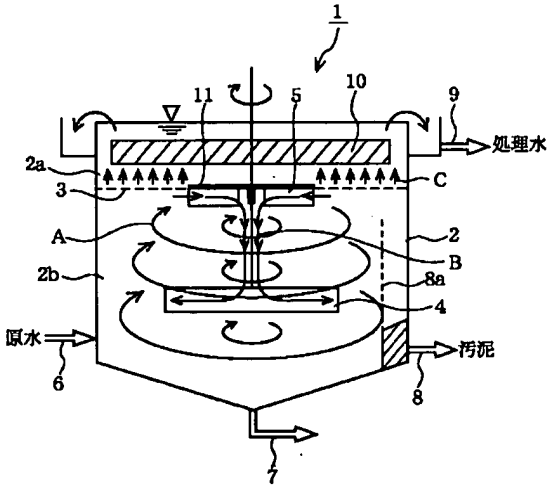
(54)【発明の名称】　撹拌流形成手段を有する固液分離装置

(57)【要約】
【課題】　慣性力によって粒子群の移動速度と移動方向を制御することで固液分離の分離効率や分離速度を上げコンパクトで安価な固液分離装置を提供する。
【解決手段】　分離槽２内には内部空間を上部分離域２ａと下部流動域２ｂとに分割する多孔部材３が配設されている。下部流動域２ｂには撹拌翼４が配設されている。多孔部材３の下面中央部には撹拌翼４により発生した旋回流Ａを下向流Ｂに変換する案内板５が立設されている。下部流動域２ｂ内の被処理水の沈降性物質は撹拌翼４の回転により生じた旋回流Ａによる水平方向の慣性力で流動するために、原水流入量等に依存する上昇流Ｃに同伴しにくく、下向流Ｂにより下方向の力を受け、分離される。



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【特許請求の範囲】

【請求項1】　被処理液を分離水と沈降性物質とに固液分離する分離槽と、該分離槽内を上部分離域と下部流動域とに分割する多孔部材と、上部分離域に設けられた分離水導出手段と、下部流動域に設けられた撹拌流形成手段、被処理水導入手段、および沈降性物質排出手段と、多孔部材下面および／または下部流動域底部に設けられた鉛直流形成手段とを備えたことを特徴とする撹拌流形成手段を有する固液分離装置。

【請求項2】　撹拌流形成手段は、下部流動域内に水平方向に周回する旋回流を形成させる一枚または二枚以上の撹拌羽根を備えた放射流型撹拌翼であることを特徴とする請求項1記載の撹拌流形成手段を有する固液分離装置。

【請求項3】　鉛直流形成手段は、下部流動域内の旋回流を軸心に沿った鉛直流に変換する一枚または二枚以上の案内板であることを特徴とする請求項1または請求項2記載の撹拌流形成手段を有する固液分離装置。

【請求項4】　被処理液を分離水と沈降性物質に固液分離する分離槽と、該分離槽を上部分離域と下部流動域とに分割する多孔部材と、上部分離域に設けられた分離水導出手段と、下部流動域に設けられた撹拌流形成手段、被処理液導入手段および沈降性物質排出手段と、下部流動域の内壁面に設けられた向心流形成手段とを備えたことを特徴とする撹拌流形成手段を有する固液分離装置。

【請求項5】　撹拌流形成手段は、下部流動域内に鉛直方向に循環する循環流を形成させる一枚または二枚以上の撹拌羽根を備えた軸流型撹拌翼であることを特徴とする請求項4記載の撹拌流形成手段を有する固液分離装置。

【請求項6】　向心流形成手段は、下部流動域内の旋回流を軸心方向の向心流に変換する一枚または二枚以上の案内板であることを特徴とする請求項4または請求項5記載の撹拌流形成手段を有する固液分離装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、例えば活性汚泥処理における沈殿池、沈殿槽（処理水－沈殿汚泥の分離）、汚泥処理における汚泥濃縮槽（分離水－濃縮汚泥の分離）、凝集沈殿処理等の固液分離槽（分離水－凝沈汚泥の分離）などの液相と固相の分離全般に好適に用いられる固液分離装置に関するものである。

【0002】

【従来の技術】一般に、廃水等に対する固液分離の手法は、①重力による分離（自然沈降分離や凝集沈殿等）、②遠心力による分離（サイクロンや遠心分離機等）、③微小な孔径を有する不連続面を利用した沪過による分離（沪布、膜、スクリーンまたは砂層等）、④凝集分離（凝集付着力を利用した沪過等）、⑤電気的な力による分離（電気泳動分離等）、⑥磁力による分離（磁気分離等）、⑦慣性力による分離に分類される。

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【0003】このうち、慣性力による分離は気－固分離における集塵操作や固－固間の分級や分離操作に多く利用されているが、液体の密度や粘度が気体に比べて大きいために、固－液分離にはあまり用いられておらず、コアンダ効果を利用した分級装置やスワール等のように旋回流を利用した分離装置（竹田茂夫氏による「スワール分水槽による合流式下水道の越流対策」下水道協会誌第26巻第297号1989／2参照）程度しか知られていない。

【0004】一般に、慣性力による分離は装置内のスラリーの流動による慣性力に伴う粒子群の移動速度（方向を含む）と固液分離速度（方向を含む）の比を利用して分離するものである。

【0005】

【発明が解決しようとする課題】しかしながら、従来の慣性力による分離装置では、①原水流入量と、②装置の形状および大きさによって、その分離性能が決まってしまい、分離効率や分離速度を大きくできないという課題があった。また、通常の固液分離装置（沈殿池など）では、安定した処理水質を得るために広大な敷地を要し、各種の付帯設備を必要とするという課題もあった。

【0006】この発明は上記のような課題を解決するためになされたもので、慣性力による粒子群の移動速度と移動方向を制御することで固液分離の分離効率や分離速度を上げコンパクトで安価な固液分離装置を提供することを目的とする。

【0007】

【課題を解決するための手段】この発明に係る撹拌流形成手段を有する固液分離装置は、被処理液を分離水と沈降性物質とに固液分離する分離槽と、該分離槽内を上部分離域と下部流動域とに分割する多孔部材と、上部分離域に設けられた分離水導出手段と、下部流動域に設けられた撹拌流形成手段、被処理水導入手段、および沈降性物質排出手段と、多孔部材下面および／または下部流動域底部に設けられた鉛直流形成手段とを備えたことを特徴とするものである。

【0008】この発明に係る撹拌流形成手段を有する固液分離装置は、撹拌流形成手段として、下部流動域内に水平方向に周回する旋回流を形成させる一枚または二枚以上の撹拌羽根を備えた放射流型撹拌翼を用いたことを特徴とするものである。

【0009】この発明に係る撹拌流形成手段を有する固液分離装置は、鉛直流形成手段として、下部流動域内の旋回流を軸心に沿った鉛直流に変換する一枚または二枚以上の案内板を用いたことを特徴とするものである。

【0010】この発明に係る撹拌流形成手段を有する固液分離装置は、被処理液を分離水と沈降性物質に固液分離する分離槽と、該分離槽を上部分離域と下部流動域とに分割する多孔部材と、上部分離域に設けられた分離水

導出手段と、下部流動域に設けられた撹拌流形成手段、被処理液導入手段および沈降性物質排出手段と、下部流動域の内壁面に設けられた向心流形成手段とを備えたことを特徴とするものである。

【００１１】この発明に係る撹拌流形成手段を有する固液分離装置は、撹拌流形成手段として、下部流動域内に鉛直方向に循環する循環流を形成させる一枚または二枚以上の撹拌羽根を備えた軸流型撹拌翼を用いたことを特徴とするものである。

【００１２】この発明に係る撹拌流形成手段を有する固液分離装置は、向心流形成手段として、下部流動域内の旋回流を軸心方向の向心流に変換する一枚または二枚以上の案内板であることを特徴とするものである。

【００１３】

【発明の実施の形態】以下、この発明の実施の一形態を説明する。

実施の形態１．図１はこの発明の実施の形態１による固液分離装置の構成を示す断面図であり、図２は図１の平面図である。図において１は固液分離装置である。固液分離装置１は、有底略円筒状の分離槽２と、この分離槽２内に水平に配されて分離槽２を上部分離域２ａと下部流動域２ｂとに分割する平板状の多孔部材３と、分離槽２の上部から垂下されかつ多孔部材３の下面に平行な旋回流Ａを形成する撹拌翼（撹拌流形成手段）４と、多孔部材３の下面に設けられかつ撹拌翼４により生じた旋回流Ａを下向流Ｂに変換する案内板（鉛直流形成手段）５と、下部流動域２ｂに原水（被処理液）を導入するための原水導入部（被処理液導入手段）６と、分離槽２の下部流動域２ｂ内のスラッジ等の沈降性物質を装置外に排出するためのスラッジ取出部（沈降性物質排出手段）７と、分離槽２の下部流動域２ｂ内の底部に設けられスラッジ等の沈降性物質を沈降させて濃縮した濃縮スラッジを装置外に排出する濃縮スラッジ取出部（沈降性物質排出手段）８と、分離槽２の上部分離域２ａ内の分離水を処理水として溢流させて排出する処理水取出部（分離水導出手段）９と、分離水中に残留する沈降性物質（ピンフロックなど）の沈降を促進する沈降促進部材１０とから概略構成されている。

【００１４】分離槽２の底部は円錐形状に形成されており、その最深部にスラッジ取出部７が設けられている。この実施の形態１における分離槽２の水平断面は、下部流動域２ｂにおいて撹拌翼４の回転により水平方向に周回する旋回流Ａが形成されるために、その旋回流Ａが下部流動域２ｂ内で確実に形成・維持され易いように円形とされているが、例えば正八角形、正六角形などの点対称の水平断面を有していれば、特に制限はない。

【００１５】多孔部材３は原水若しくは沈降性物質が分離した分離水の通過を妨げない複数の貫通孔を有し、下部流動域２ｂの流動が上部分離域２ａに概ね及ばないように両域を区分する平板状のものである。この多孔部材３としては、例えば金網、パンチングプレート、エキスパンドメタル、特殊多孔板、薄板状や粒状の充填層等を用いることができる。また、多孔部材３は、撹拌翼４が位置する下部流動域２ｂと処理水取出部９が位置する上部分離域２ａとの間で分離槽２を上下に分割するように水平に設置される。なお、多孔部材３のうち、案内板５が立設された部分には旋回流Ａを下向流Ｂに変換させる際に、上向流が形成されるのを阻止するために、また内壁近傍には内壁に沿って上昇する上向流を阻止するために、上記貫通孔を設けないか、止水部材１１を図１および図２に示すように設けることが望ましい。

【００１６】一般に撹拌翼は単数の撹拌羽根または複数の撹拌羽根を備えており、この撹拌翼４が一本の軸に固定され駆動手段（図示せず）を有するものが撹拌機（撹拌装置）である。なお、撹拌翼は一本の軸に複数設けられることもできる（多段型）。この実施の形態１における撹拌翼４の形状は図１に示すように下部流動域２ｂ内において主に水平方向に周回する旋回流Ａを形成する放射流型である。この放射流型の撹拌翼は一般に平板な撹拌羽根が回転することにより、主に水平方向に周回する流れを形成する形状を有している。撹拌翼４には、図２に示すように４枚の羽根が回転軸に配置されているが、翼の数は少なくとも１段あればよく、その段数に制限はない。また、撹拌翼４の羽根の枚数は限定されたものではない。下部流動域２ｂ内に設けられた撹拌翼４の設置位置は多孔部材３と分離槽２の底部との間とされ、分離槽２の内部形状や案内板５の設置位置等に応じて上部、中部および下部のうちから適宜設定される。撹拌翼４の回転数は駆動装置（図示せず）の制御により被処理液中の沈降性物質である微細粒子群の物性を考慮して適宜変更可能である。撹拌翼４の形状としては、全ての形状の翼を使用できるが、旋回流を効率良く発生させるためには公知のパドル型、特殊パドル型、標準ラストン型、タービン型等の水平流を形成できる放射流型を用いる方がよい。撹拌翼４により下部流動域２ｂ内で理想的な撹拌状態を得るためには、下部流動域２ｂの内径をＬとし、撹拌翼４の径をＤとすると、比Ｄ／Ｌ＝０．３～０．７の範囲を満たすように両者の寸法が設定される。なお、分離槽２の形状などの都合により、撹拌翼４を設置できない場合には、下部流動域２ｂ内に水平方向の流れを作ることができる噴流装置（サーキュレーター等）を設置してもよい。

【００１７】案内板５は、図１に示すように多孔部材３の下面に垂下状態で設置され、図２に示すように多孔部材３の中心部を中心にして４枚の板が放射状に固定されており、これに衝突した旋回流Ａの一部を下向流Ｂに変換するものである。この鉛直流Ｂとは、旋回流Ａの一部が案内板５により生じる鉛直方向の流れをいう。因みに、案内板５は、実施の形態２で後述されるように下部流動域２ｂの底部に立設する場合には、旋回流Ａの一部

を上向流B´に変換するものである。また、案内板5は正方形あるいは矩形の平板状のものであるが、湾曲形状をなしていてもよい。なお、案内板5の枚数は少なくとも1枚あればよく、その枚数に制限はない。

【0018】原水導入部6の設置位置は、図2に示すように撹拌翼4により形成される旋回流Aを乱さないために略円筒状の下部流動域2bの内壁面に沿って原水を下部流動域2b内に導入するように配慮されている。原水の下部流動域2bへの導入は、内壁に設けた開口を用いても導入管を用いてもよいが、いずれにおいても下部流動域2b内の旋回流Aを阻害せず、また旋回流Aの形成・維持ができるように、下部流動域2bの内壁に沿わせるような水平の流れが形成されるように導入することが望ましい。なお、前述した撹拌翼4などの旋回流形成手段と組み合わせることにより下部流動域2b内に効率よく旋回流Aを形成・維持することができる。

【0019】スラッジ取出部7は下部流動域2b内の底部に設けられてスラッジ等の沈降性物質を引き抜くものであり、濃縮スラッジ取出部8は分離槽2の一部に設けた隔壁8aにより撹拌翼4や案内板5による撹拌流動の影響を排除して流動が静止する部分を形成し、その隔壁8a内にスラッジを沈降させて濃縮し、その濃縮スラッジを装置外に排出するものである。なお、この濃縮スラッジ取出部8は必要に応じて設けられるものである。

【0020】処理水取出部9としては上部分離域2a内の流動を均一にして集水する集水設備を用いることができる。沈降促進部材10は必要に応じて設けられるものであり、この沈降促進部材10を設ける場合には、所定の離間距離をもって複数の平行板を組み合わせたパラレルプレート、所定の離間距離をもって複数の波板を組み合わせたコルゲーテッドプレート等の傾斜板、複数の円管や角管を組み合わせた沈降管、支持材や枠組中に短管や粒状担体を充填して分離面積を増大させて分離効果を上げる充填層、多孔板またはスクリーン等の整流材などを用いることができるが、上部分離域2a内の分離水中に残留するピンフロックなどの沈降を促進するものであれば、特に制限されるものではない。なお、傾斜板や沈降管は分離槽2内にそのまま設置してもよく、また支持材で支持して設置してもよい。

【0021】このような構成の分離槽2内における固液分離における作用について説明する。一般に慣性力による固液分離は、スワール等を例にとると、分離速度V_Lは槽断面積Sと原液流入量Q_Iと汚泥排出量Q_uによって$V_L=(Q_I-Q_u)/S$で示される。そこで、スワールでは流入法を工夫し、装置内に分離速度V_Lより大きな速度の流速V_cの旋回流Aを発生させて粒子群をその旋回流Aに乗せて移動させると、その粒子群はその慣性力により、分離速度V_Lの上昇流Cに同伴しにくくなり、分離速度V_Lよりも小さな沈降速度をもつ微細粒子群も上昇せず、旋回流Aの流れに乗り運動するため、小さな粒子群も分離できるわけである。但し、スワールでは旋回流Aの大きさを大きく採れなかったり、旋回流Aによる乱れが分離域にあったりして分離効率が悪くなるので、スワールでは汚泥排出量Q_uを大きくして分離速度V_Lを小さくし、少しでも分離効率を上げようとしている。

【0022】そこで、この実施の形態1では、図1に示すように下部流動域2b内に回転数を自由に変えることのできる撹拌翼4を設置し、それを回転させることにより下部流動域2b内に導入された原水に力を加えて下部流動域2b内に旋回流Aを発生させ、その速度を従来の装置に比べて大きく採れるようにすると、分離速度V_Lよりも小さい沈降速度をもつ微細粒子群にも水平方向の慣性力が与えられて、それによって運動しているため、分離速度V_Lの上昇流Cに同伴しにくくなる。それは従来よりも慣性力が大きいために更に同伴しにくくなっている。即ち、分離効率や分離速度が大きく採れることになる。但し、撹拌による流動は分離槽2内の全体に及ぶので、上部分離域2aへの影響をなくしてやらなければならない。

【0023】即ち、下部流動域2b内の流動に関する流量は原水流入量Q_Iと撹拌吐出量Q_dであるからQ_I+Q_dが基本になる。従って、分離槽2内の平均流速を代表する指標は$V_a=(Q_I+Q_d)/S$となる。このQ_I+Q_dによって、流速V_cの旋回流Aが発生するが、このような撹拌の影響が分離槽2の上部分離域2aにあると、その分離速度V_L‘はV_L‘$=(Q_I+Q_d-Q_u)/S$となり、Q_dの分だけ、分離速度が大きくなってしまうので、当然分離効率が悪くなる。そのため、分離に関しては撹拌吐出量Q_dを0（零）にすることにより分離効率が上がるわけである。

【0024】そこで、撹拌翼4の設置位置から上部の適当な位置に、水は通過するが流動を阻止する多孔部材3を分離槽2を上下に分割するように水平に設置する。これにより、撹拌の影響は多孔部材3の下側の下部流動域2bでは有効であるが、上側の上部分離域2aでは影響はなくなる。従って、上部分離域2aの上昇流Cは分離速度$V_L=(Q_I-Q_u)/S$となるので、分離効率がよくなる。このように従来の固液分離装置と比べて旋回流Aの流速V_cを大きく採れるため、分離効率も分離速度も大きく採れることになる。

【0025】次に動作について説明する。まず、沈降性物質である微細粒子群を含む原水は原水導入部6から下部流動域2b内に一定の流量で導入される。この際、原水は、図2に示すように下部流動域2bの内壁面に沿って導入され、下部流動域2b内に水平方向の旋回流Aを発生し易くする。このとき、多孔部材3が分離槽2を上下に分割するように水平に配置されているので、この不連続面を形成する多孔部材3の阻害作用により多孔部材3の上側の上部分離域2aにおいては撹拌翼4による撹

拌の影響のほとんどない緩やかな上昇流Cが形成される。

【0026】次に、下部流動域2b内に導入された原水には撹拌翼4の回転により強い流動が与えられる。このとき、下部流動域2b内の底部において放射流型の撹拌翼4により下部流動域2bの内周壁面に沿って周回する旋回流Aが形成されると同時に、この旋回流Aの一部が案内板5により、回転軸心に沿って下部流動域2bの底部に向けて下降する下向流Bとなる。この下向流Bは、旋回流Aにより与えられた慣性力により上昇流Cに同伴しにくくなっている微細粒子群に対して下方向の力を与えるものであり、この下向流Bにより上昇流Cから分離しようとする微細粒子群は効率よく分離される。このようにして分離された微細粒子群は多孔部材3の下側の下部流動域2bで流動し濃縮され、汚泥濃度が高くなるため、適宜、スラッジとして下部流動域2bの底部に設けられたスラッジ取出部7あるいは濃縮スラッジ取出部8から引き抜く。場合によっては、引抜前に撹拌翼4を一時的に停止させて微細粒子群等の沈降性物質を底部に沈殿させ、沈殿して高濃度化した汚泥を引抜いてもよい。

【0027】一方、沈降性物質が分離した分離液は上昇流Cに乗って上部分離域2aを通過して処理水取出部9から溢流させる。その際に、上部分離域2a内に設けた傾斜板等の沈降促進部材10を利用することにより、上昇流Cと同伴したピンフロックなどを沈降除去でき、更に上質の処理水を得ることができる。

【0028】以上のように、この実施の形態1によれば、撹拌流形成手段としての撹拌翼4を設けたことにより、上昇速度より大きい流速の水平方向の旋回流Aを物理的（機械的）に形成され、流入する原水中の微細粒子群に慣性力を与え、これにより微細粒子群が上部分離域2a内を上昇する上昇流Cに同伴して上昇するのを妨げることができる。また、原水が下部流動域2bに順次流入し上昇流Cが維持されるため、微細粒子群は少なからず上方向への力を受けるが、鉛直流形成手段としての案内板5を設けたことにより、旋回流Aの一部を回転軸心に沿った下向流Bとすることができるので、この下向流Bにより原水中の微細粒子群に下方向への力を与えることができ、従来の固液分離装置において律速因子であった原水流入量や装置の形状および大きさに関係なく、一般的な重力沈殿に比べ短い滞留時間で効率よく、原水を微細粒子群と分離水とに固液分離することができる。

【0029】この実施の形態1では、多孔部材3、撹拌流形成手段としての撹拌翼4および鉛直流形成手段としての案内板5を設けたことにより、従来の固液分離装置に比べて分離速度や分離効率を大幅に向上させることができるので、よりコンパクトになり、敷地面積も小さくでき、建設費も安価にすることができる。

【0030】この実施の形態1では、撹拌流形成手段としての撹拌翼4の回転数を変更可能としたことにより、原水中の沈降性物質である微細粒子群の物性に適応した回転数を選べば、同一の装置でも原水の水質や水量の変化に適応して処理することができる。

【0031】なお、この実施の形態1では、分離槽2の底部を円錐形状としたが、平坦面としてもよい。

【0032】実施の形態2．図3はこの発明の実施の形態2による固液分離装置の構成を示す断面図である。この実施の形態2の構成要素のうち実施の形態1の構成要素と共通する部分については同一符号を付し、その部分の説明を省略する。

【0033】この実施の形態2では、鉛直流形成手段としての案内板5を分離槽2の底部に立設し、この案内板5と多孔部材3との間に旋回流Aを形成する撹拌流形成手段としての撹拌翼4が配設されている。この実施の形態2では、図3に示すように下部流動域2b内の上方に位置する撹拌翼4により生じた水平方向の旋回流Aが下部流動域2bの底部に立設された案内板5により、回転軸心に沿って上昇する上昇流B´に変換されるが、撹拌翼4の回転により多孔部材3の下面近傍の下部流動域2b内を多孔部材3の周縁部へ向けて送り出され、下部流動域2bの内周壁面に沿って下向流B（下方向の鉛直流）となり、この下向流Bにより原水中の微細粒子群に下方向への力を与えることができ、固液分離の効率化を図ることができる。また、下部流動域2bの下層付近を鉛直方向にも十分撹拌でき、下部流動域2b内を均質化することができる。

【0034】以上のように、この実施の形態2によれば、下部流動域2bの底部に立設した案内板5により、旋回流Aを撹拌翼4の回転軸に沿って上昇する上昇流B´（上方向の鉛直流）に変換し、多孔部材3の周縁部付近で下向する下向流B（下方向の鉛直流）に変換できるので、これにより微細粒子群に下方向への力を与えることができ、実施の形態1の場合と同様に、重力沈殿による従来の凝集分離装置に比べて短い滞留時間で効率よく、被処理液を沈降性物質と分離水とに固液分離することができると共に、下部流動域2b内を均質化することができる。

【0035】この実施の形態2では、上部分離域2aに実施の形態1における沈降促進部材（図示せず）を設けていないが、必要に応じて設けてもよい。また、この実施の形態2では、下部流動域2bに実施の形態1における濃縮スラッジ取出部（図示せず）を設けていないが、必要に応じて設けてもよい。

【0036】実施の形態3．図4はこの発明の実施の形態3による固液分離装置の構成を示す断面図である。この実施の形態3の構成要素のうち実施の形態1等の構成要素と共通する部分については同一符号を付し、その部分の説明を省略する。

【0037】この実施の形態3では、撹拌翼4として主に下部流動域2b内を鉛直方向に撹拌する循環流Dを形

成する軸流型のものが採用され、多孔部材３の周縁部であって下部流動域２ｂの内壁面またはその近傍には複数の案内板５（向心流形成手段）が立設されている。また、後述の上向流が下部流動域２ｂから上部分離域２ａへ移行するのを阻止するために、多孔部材３の周縁部に貫通孔を設けないか、または止水部材１１を図４に示すように設けることが望ましい。

【００３８】一般に撹拌翼は単数の撹拌羽根または複数の撹拌羽根を備えており、この撹拌翼４が一本の軸に固定され駆動手段（図示せず）を有するものが撹拌機（撹拌装置）である。なお、撹拌翼は一本の軸に複数設けられることもできる（多段型）。この実施の形態３における撹拌翼４の形状としては、公知のプロペラ型、パドル型、ハイドロフォイル型、タービン型などの循環流を形成できる軸流型を用いることができる。また、分離槽２の形状としては、実施の形態１で採用したものと同様に円筒状であるが、とくに下部流動域２ｂ内における均質な循環流Ｄの形成が阻害されない形状であれば、これに限られるものではない。望ましくは、点対称な水平断面を有するものがよい。そして、後述の旋回流Ａの形成を妨げ上下方向の循環流Ｄを形成しやすくするために、下部流動域２ｂの内壁に鉛直方向に延在する邪魔板１２（阻流板）などを設けると有効である。これに伴って、原水導入部６からの分離槽２内への原水導入は下部流動域２ｂに対して行われれば、どのような方向に行われてもよい。なお、撹拌翼４は、図２に示すように２枚の羽根で構成されているが、羽根の枚数は少なくとも１枚あればよく、その枚数に制限はない。

【００３９】次に分離槽２内の流動について説明する。撹拌翼４のプロペラ状の撹拌羽根が回転することにより、鉛直下方向に水流が吐出し、下部流動域２ｂの底部で回転軸心から内壁に向かう水平方向の底層流が形成され、内壁に沿って上昇する上向流が形成され、この上向流が多孔部材３により水平流（向心流）Ｅが形成され、回転軸心近傍で上記下向流Ｂに合流する一連の循環流Ｄが下部流動域２ｂに形成される。また、軸流型の撹拌翼４による回転運動により副次的に下部流動域２ｂを水平方向に周回する旋回流Ａが形成される。撹拌翼４により形成される循環流Ｄは撹拌翼４の回転軸と下部流動域２ｂの内壁面に沿って鉛直方向の流れ（上向流および下向流Ｂ）と、回転軸心と内壁との間を流れる水平方向の流れ（底層流および向心流Ｅ）とから構成されている。上述の撹拌翼４の回転により副次的に生じる旋回流Ａは案内板５に衝突することで回転軸心に向かう水平流である向心流Ｅ´に変換され、撹拌翼４による循環流Ｄの向心流Ｅを補足し効率を上げるために利用される。

【００４０】下部流動域２ｂ内では、撹拌翼４による循環流Ｄにより撹拌混合が行われ、向心流Ｅが形成されると共に案内板５により変換される向心流Ｅ´が形成され、これらにより原水中の微細粒子群等の沈降性物質に水平方向の慣性力が与えられる。

【００４１】さて、水平方向の向心流Ｅ＋Ｅ´に乗って微細粒子群が移動するため、特に小さな微細粒子群は慣性力によって上昇流Ｃに同伴しにくくなり、さらに、回転軸心に沿って生じる下向流Ｂにより微細粒子群に対して下方向の力を与えることができ、これにより効率よく微細粒子群が上昇流Ｃから分離される。このようにして分離された微細粒子群は下部流動域２ｂに残存し、微細粒子群が分離した分離水は上昇流Ｃに乗って上部分離域２ａを通過して処理水取出部９から滋流させる。その際に、上部分離域２ａ内に設けた傾斜板等の沈降促進部材（図示せず）を利用することにより、上昇流Ｃと同伴したピンフロックなどを沈降除去でき、更に上質の処理水を得ることができる。

【００４２】下部流動域２ｂでは、下向流Ｂにより分離された微細粒子群が残留して濃縮され、汚泥濃度が高くなるため、適宜、底部に設けられたスラッジ取出部７から直接外部に引き抜く。場合によっては、引抜前に撹拌翼４を一時的に停止させて、汚泥を底部に沈殿させ、高濃度化した汚泥を引き抜いてもよい。

【００４３】以上のように、この実施の形態３によれば、軸流型の撹拌翼４を設けたことにより、下部流動域２ｂに多孔部材３の下面に回転軸心に向かう水平流（向心流Ｅ）を形成すると共に、さらに旋回流Ａを案内板５により向心流Ｅ´に変換することができるので、分離速度V_Lよりも小さい沈降速度をもつ沈降性物質に対しても水平方向の慣性力を与えることで多孔部材３を通過する上昇流Ｃへ同伴しにくくし、さらに、下向流Ｂにより微細粒子群に対して下方向の力を与えることができ、これにより実施の形態１等の場合と同様に分離効率および分離速度を向上させることができ、従来の固液分離装置において律速因子であった原水流入量や装置の形状および大きさに関係なく、一般的な重力沈殿に比べ短時間で効率よく固液分離を行うことができる。

【００４４】

【発明の効果】以上説明したように、この発明によれば、多孔部材および撹拌流形成手段を設けたことにより、下部流動域において原水中の沈降性物質に対して水平方向の慣性力を与えて上昇流に同伴しにくくすると共に、撹拌流形成手段が旋回流形成手段であれば、鉛直流形成手段により形成される鉛直下方向の下向流を利用し、撹拌流形成手段が循環流形成手段であれば、その循環流を構成する鉛直下方向の下向流を利用し、これにより沈降性物質に対して下方向の力を与えることで、従来の固液分離装置において律速因子であった原水流入量や装置の形状および大きさに関係なく、一般的な重力沈殿に比べ短時間で効率よく固液分離を行うことができる。従って、この発明に係る固液分離装置は、特に微細粒子群等の沈降性物質の固液分離操作に適するので、化学プロセスにおける固液分離操作、水環境保全および水利用

における水処理装置や汚泥処理装置の固液分離操作に適用すれば、効果的である。

【００４５】この発明によれば、多孔部材、撹拌流形成手段および鉛直流形成手段あるいは向心流形成手段を設けたことにより、従来の固液分離装置に比べて分離速度や分離効率を大幅に向上させることができるので、よりコンパクトになり、敷地面積も小さくでき、建設費も安価にすることができる。

【００４６】この発明によれば、上部分離域に沈降促進部材を設けたことにより、多孔部材を通過した分離水中にピンフロック等が含まれた場合であっても、これを速やかに沈降させることができるので、分離効率や処理水質を向上させることができる。

【図面の簡単な説明】

【図１】この発明の実施の形態１による固液分離装置の構成を示す断面図である。

【図２】図１の平面図である。

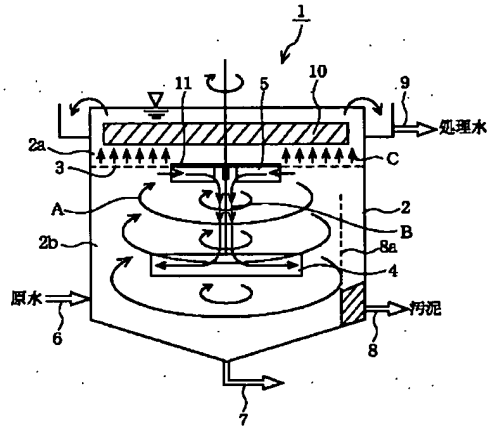
【図３】この発明の実施の形態２による固液分離装置の構成を示す断面図である。

【図４】この発明の実施の形態３による固液分離装置の構成を示す断面図である。

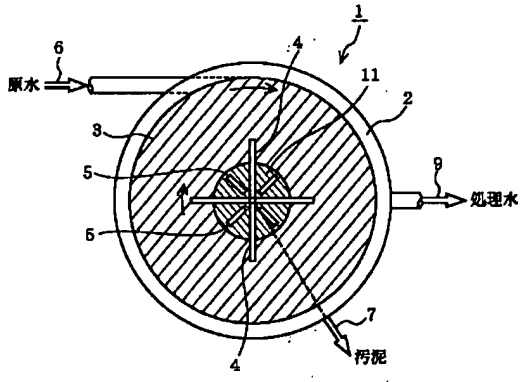
【符号の説明】

１　固液分離装置
２　分離槽
２ａ　上部分離域
２ｂ　下部流動域
３　多孔部材
４　撹拌翼（撹拌流形成手段、放射流型、軸流型）
５　案内板（鉛直流形成手段、向心流形成手段）
６　原水導入部（被処理液導入手段）
７　スラッジ取出部（沈降性物質排出手段）
８　濃縮スラッジ取出部（沈降性物質排出手段）
９　処理水取出部（分離水導出手段）
１０　沈降促進部材
１１　止水部材（無孔部）
１２　邪魔板
Ａ　旋回流
Ｂ，Ｂ'　鉛直流（下向流、上向流）
Ｃ　上昇流
Ｄ　循環流
Ｅ，Ｅ'　向心流

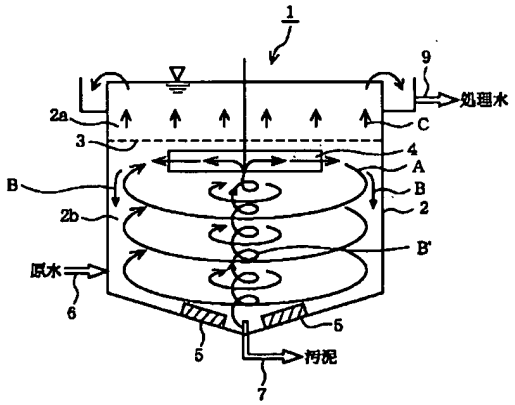
【図１】



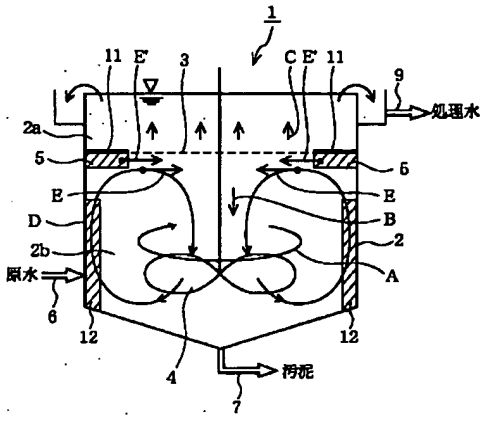
【図２】



【図３】



【図4】



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